AVOIDANCE OF TRANSCODING OR INTERRUPTION IN THE EVENT OF PAYLOAD CODING EXCHANGES IN EXISTING CONNECTIONS

CLAIM FOR PRIORITY

This application is a national stage of PCT/DE2003/002223, published in the German language on January 15, 2004, and which claims the benefit of priority to German Application No. DE 102 31 027.0, filed on July 9, 2002.

TECHNICAL FIELD OF THE INVENTION

The invention relates to a method and devices for signaling a modification of the coding of a user data connection section termination at a media gateway from a media gateway controller to the media gateway.

BACKGROUND OF THE INVENTION

In ITU-T protocols H.248 and Q.1950 the control of so-called media gateways (MGWs = switching devices in particular in a cellular mobile radio network or fixed network) is specified by so-called media gateway controllers (MGCs). The protocol Q.1950 is used in conjunction with the BICC protocol Q.1902.4 also specified by the ITU-T. These protocols can also be used for 3GPP applications. Media gateways for example connect user connection sections (for the transmission of user data such as voice, text, multimedia) of a telecommunication network and in some instances convert different codings, e.g. voice codings such as G.711 or AMR, to each other. User connection section termination, abbreviated to termination, refers below to the termination of a section of a user connection switched through the MGW, e.g. for voice or multimedia (sound and image) at this MGW. The MGW sends and/or receives (user) data associated with the user connection through said termination. In the parlance

of the protocols H.248 and Q.1950 a so-called termination corresponds to a user connection section termination.

The above-mentioned protocols allow existing user connections to be modified, e.g. by selecting a different coding. The signaling thereby used between MGC and MGW (protocols H.248 and Q.1950) is such that each termination into the MGW is modified irrespective of the other terminations connected to it within the MGW. For example the MGW can be instructed to use a different coding at this termination or to send and/or receive no data. When a termination is modified, the MGW does not know whether other connections also connected by it to said termination will also be modified later. Therefore when a termination is modified the MGW must immediately implement measures if different codings result in connected terminations (in the parlance of the protocols H.248 and Q.1950 interconnected terminations are located within an MGW in a so-called common context) and these are converted to each other for example by so-called transcoding. In specific cases however the coding of all terminations interconnected into the MGW, which are in the same context, should be modified almost simultaneously, for example in the context of the so-called BICC codec modification or codec renegotiation (see Q.1902.4), by means of which the coding of existing voice connections can be modified. The 3GPP also uses the said BICC procedures to switch existing user connections between voice and multimedia (i.e. a combination of voice and image in a common coding). The MGC can identify such situations based on the so-called call control signaling coming into it, e.g. Q.1902.4. As the signaling of the MGC to the MGW is sequential, in the event of almost simultaneous switching of all connected terminations within an MGW a possibly unwanted response results. The MGW briefly activates a transcoder, which is then almost immediately deactivated again. This generates an unnecessary

workload in an MGW and reduces its throughput. It would be acceptable but has hitherto not been technically possible to break the connection for a short time. When the first termination is modified, the MGW may also determine that it cannot convert the new coding of this termination into the coding still used at the other termination(s). This can happen for example when switching between a voice connection and a multimedia connection or a general data connection. In this case the MGW therefore rejects the modification of the user connection via H.248/Q.1950 signaling.

SUMMARY OF THE INVENTION

The present invention enables the most efficient possible switching of codings in terminations at a media gateway on the instruction of a media gateway controller and to enable switching between codings, which the media gateway cannot convert to each other. The object is achieved respectively by the subject matter of the independent Claims. According to the invention an unnecessary workload due to the brief powering up and powering down of a transcoder into the MGW can be avoided in that the media gateway controller instructs the media gateway by appropriate signaling only to implement a verification of the connectability of terminations after receipt of a plurality of instructions to modify the coding of a termination (and in some instances receipt of a specific instruction to start a comparison) (because the powering up of a transcoder would only take place after a comparison showing that the terminations to be connected or which have already been connected during a coding modification no longer use the same coding, which is not the case here).

Switching between user connections, for which the MGW does not support transcoding, is enabled. This for example enables switching between user connections for voice and multimedia.

The following embodiments, which are not limiting but rather exemplary, are particularly advantageous:

1. In the H.248/Q.1950 protocols in the case of signaling for the modification of a termination one or a plurality of voice element(s) is/are also used, with which the MGC instructs the MGW only to verify whether it can connect the terminations to each other in their new coding, after receipt of instructions to modify a plurality of terminations connected within the MGW.

2. In a preferred embodiment of 1 the MGW does not forward user data from and to the relevant terminations, once it has received an instruction to modify for said termination. After the verification specified in 1, the MGW restores the connection between the relevant terminations.

3. In a preferred embodiment of 1 and 2 the MGW cannot isolate the relevant termination immediately after receipt of the instruction from the MGC to modify but must wait until switching of the coding is prompted by means of a subsequent separate signaling with the (MGW) switching node at the other end of the user connection section. This breaks the user connection for a quite short period.

4. In a preferred embodiment of 1 to 3 the MGW cannot restore the connections immediately after the verification specified in 1 but must wait until switching of the coding at said terminations has also been prompted by means of separate signaling with the (MGW) switching node at the other ends of the user connection sections to be reconnected.

5. In a preferred embodiment of 1 and 2 the MGW can reconnect the originally connected terminations in their old coding, if the MGW determines during the verification specified in 1 that it cannot connect the terminations together in their new coding. The MGW can also signal this error to the MGC.

6. In a preferred embodiment of 5 the MGW can transmit the corresponding error message to the MGC as a response to the

instruction to modify the last termination. The MGC is then able to utilize mechanisms already existing in BICC, Q.1902.4 and Q.1950 to reject the modification of the user connections.

7. In a preferred embodiment of 1 and 2 an extension of the existing instructions to modify a termination is used as the voice element.

8. In a preferred embodiment of 7 this extension should be contained in the first corresponding instruction for a termination. Only after the arrival of the last corresponding instruction for a connected termination should the MGW verify whether it can connect the terminations together in their new coding. This solution is easily inserted into the existing BICC message flows. No additional messages are required, just new voice elements within existing messages.

9. In a preferred embodiment of 8 the newly inserted voice element can be included in all instructions to modify originally connected terminations. This simplifies the task of the MGC and the MGW.

10. As an alternative to 8, in a preferred embodiment of 7 an extension can be included in the first instruction and also optionally in further instructions to modify connected terminations. This extension instructs the MGW not to implement a verification according to 1 until an instruction is received with an additional extension. This additional extension instructs the MGW to implement the verification according to 1.

11. In a preferred embodiment of 7 the newly inserted voice element can be a characteristic of the so-called H.248 context.

12. As an alternative to 11 in a preferred embodiment of 7 the newly inserted voice element can be a characteristic of the so-called H.248 termination.

13. As an alternative to 7 in a preferred embodiment of 1 and 2 the MGC can isolate a termination by a specific instruction, before the MGC modifies the coding at said termination. Once the MGC has also modified the coding at one or a plurality of

other originally connected terminations, the MGC can reconnect the isolated termination by a further specific instruction.

14. In a preferred embodiment of 13 the MGC can isolate a termination by moving it into another so-called H.248 context.

15. In a preferred embodiment of 13 and 14 the MGC can use the so-called Q.1950 instructions "Isolate" and "Join".

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the invention will emerge from the Claims and subsequent description of an exemplary embodiment with reference to the drawing, in which:

Fig. 1 shows as an example the BICC message flow in the event of the inventive switching of a user connection from one coding to another coding.

DETAILED DESCRIPTION OF THE INVENTION

In Figure 1 the numerals indicate the time sequence of the messages they designate. Messages within the borders of the elements "Termination A" and "Termination B" relate respectively to messages from the MGC to the MGW, which relate to the corresponding termination, in particular the coding to be modified of the corresponding termination. The messages 2, 3, 4, 5, 7 and 9 are respectively confirmed by a message following immediately in the reverse direction (not shown for purposes of clarity).

The MGW is a media gateway, i.e. a switching device in a telecommunication network, and can be connected to one or a plurality of further MGWs in a packet and/or line switched manner for the transmission of user data (voice, text, multimedia) and/or signaling data (3, 7).

The MGC is a controller which controls the MGW (MGC = media gateway controller) and can be connected to one or a plurality

of further MGCs for sending and receiving signaling data (1, 6, 8, 10).

The terminations "Termination A" and "Termination B" (= user connection section terminations) are terminations of a section of a user connection switched through the MGW, e.g. for voice or multimedia (sound and image) at the MGW. The MGW sends and/or receives (user) data associated with the user connection through this termination to/from other MGWs. User data therefore arrives and/or user data is sent respectively via the terminations "Termination A" and "Termination B".

In the present instance the MGC receives the instruction 1 (Modify codec) to modify the codec (e.g. voice codec) used for a user connection. The MGC knows that this user connection is switched by the MGW via the terminations "Termination A" and "Termination B" in Figure 1 and that it must therefore instruct the MGW to modify these terminations. The MGC then uses the messages 2 (Q.1950 "Reserve characteristics") and 5 (Q.1950 "Modify characteristics") with new voice elements for this purpose.

On receipt of the instruction 1 the MGC sends the message 2 "Reserve characteristics" to the MGW. This message 2 contains an instruction from the media gateway controller MGC to the media gateway MGW to modify the characteristics of a "Termination B" connected to the media gateway. On receipt of the message 2 the MGW sends a message 3 "Modify bearer", where necessary via the connection of the "Termination B" to another MGW, prompting this other MGW to modify locally the characteristics of the bearer of the user connection section to the "Termination B", e.g. the bandwidth. The MGW then confirms successful completion to the MGC by means of the "Bearer modified" message 4.

On receipt of the instruction 4 the MGC also sends the MGW the message 5 "Modify characteristics". This message 5 contains an instruction from the media gateway controller MGC to the media gateway MGW to modify characteristics (specifically the coding here) of a "Termination A" connected to the media gateway. The MGW also receives a message 7 "Modify bearer" here via the connection of the "Termination A" from another MGW, as this other MGW was informed of the planned modification of the coding for the connection of the "Termination B" via the signaling 6 to the MGC via an MGC/MGW (not shown).
In some instances the MGC receives a message 8 "Successful codec modification" from another MGC (not shown) relating to a successful codec modification in the other MGC.

The message 9 "Confirm characteristics" is used by the MGC to confirm to the MGW that it should retain the new characteristics (codecs).

The MGC uses the message 10 "Successful codec modification" in relation to a successful code modification in the MGW shown to confirm to another MGC (not shown) that a successful codec modification has taken place (in the MGW shown).

According to the invention the described message flow can be used and/or modified as follows. Three alternative methods a) to c) are described:

a) Method according to points 1 to 9 and 11 and 12 above: The MGC instructs the MGW in the message 2 by means of a new voice element only to implement a verification in respect of necessary transcoding after receipt of instructions for all connected terminations (here messages 2 and 5) and if necessary to insert a transcoder. On dispatch of the message 3 the MGW

isolates the termination B, so no user data can initially be transmitted via the termination B. On receipt of the message 5 the MGW determines that instructions have now been received for all terminations. The MGW then verifies whether connection of the terminations A and B is possible in the new coding. If this is not possible, the MGW sends a corresponding error message in the confirmation of receipt in relation to 5. Further error signaling is not shown here. Otherwise the MGW reconnects the terminations A and B using the new coding after receipt of the message 7.

b) Method according to points 1 to 7 and 10 to 12 above: The MGC instructs the MGW in the message 2 by means of a new voice element only to implement a verification in respect of necessary transcoding after receipt of a correspondingly marked instruction for a connected termination and if necessary to insert a transcoder. On dispatch of the message 3 the MGW isolates the termination B, so initially no user data can be transmitted via the termination B. In the message 5 the MGC instructs the MGW by means of a further new voice element to implement the specified verification. The MGW then verifies whether connection of the terminations A and B is possible in the new coding. If this is not possible, the MGW sends a corresponding error message in the confirmation of receipt in relation to 5. Further error signaling is not shown here. Otherwise the MGW reconnects the terminations A and B using the new coding after receipt of the message 7.

c) Method according to points 1 to 6 and 13 to 15 above: The MGC instructs the MGW immediately before dispatch of the message 2 by means of the additional message "Isolate" (not shown) to isolate the termination B. The MGE then forwards no user data to the termination B and also receives no user data from there. On receipt of the message 2, the MGW does not

verify whether transcoding is necessary to the termination A, as the two terminations are not connected. On receipt of the confirmation of the message 5 and before dispatch of the message 6, the MGC instructs the MGW by means of the additional message "Join" (not shown) to connect the termination B to the termination A. The MGW then verifies whether connection of terminations A and B is possible in the new coding. If this is not possible, the MGW sends a corresponding error message in the confirmation of receipt in relation to 5. Further error signaling is not shown here. Otherwise the MGW reconnects the terminations A and B using the new coding after receipt of the message 7. As an alternative to the above, the additional messages "Isolate" and "Join" can also relate to the termination A.

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Description

ARRANGEMENT FOR CONNECTING AN OPTICAL WAVEGUIDE TO A MICROPROCESSOR-CONTROLLED ELECTRICAL APPLIANCE

CLAIM FOR PRIORITY

This application is a national stage of PCT/DE2003/002223, published in the German language on January 15, 2004, and which claims the benefit of priority to German Application No. DE 102 31 027.0, filed on July 9, 2002.

TECHNICAL FIELD OF THE INVENTION

The invention relates to an arrangement for connecting an optical waveguide to a microprocessor-controlled electrical appliance.

BACKGROUND OF THE INVENTION

Electrical systems today are frequently of decentralized design, i.e. they have electrical appliances which are distributed in their arrangement and are normally microprocessor-controlled. Thus, by way of example, single appliances for telecommunication, such as telecommunication terminals and exchange equipment, together form a telecommunication network and single computers, such as PCs or servers, are connected to one another to form computer networks. Similarly, "field transmitters", such as those used in industrial production processes, power or process engineering systems or else installations for distributing electricity, gas or water, are normally arranged in decentralized fashion and are combined to form a network for the purpose of data interchange with one another and/or with a control center. Such networks may be designed, by way of example, on the basis of the generally known Ethernet

standard.

In communication networks, data to be transmitted between the individual electrical appliances are transmitted using "interconnect media". Such interconnect media used may be, by way of example, electrical transmission lines (such as twisted-pair lines) or optical waveguides. In the case of an optical waveguide, the data are transmitted in the form of pulses of light using optical fibers. To couple them to the respective appliances in the network, the optical waveguides are connected by means of appropriate interfaces to optical transmission and reception chips containing these interfaces.

The invention relates to an arrangement for connecting an optical waveguide to a microprocessor-controlled electrical appliance having an arithmetic module which is connected to the electrical appliance and has network functionalities for linking the electrical appliance to a network, an interface chip, connected to the arithmetic module, in the form of an integrated circuit chip, and an optical transmission and reception chip which is connected firstly to the interface chip and secondly to the optical waveguide.

An arrangement of this type is known, by way of example, from the German translation DE 696 15 249 T2 of the European patent specification EP 0 735 706 B1. In the case of the known arrangement, an interface device is described for the purpose of connecting an optical waveguide to an electrical appliance, the interface device having a first IC (Integrated Circuit) connected to the electrical appliance as an arithmetic module, which is in turn connected to a second IC. The latter provides an interface chip for an optical connector which has an optical transmitter and receiver

and is in turn connected to the optical waveguide. The entire interface device may be used to convert input data generated in an electrical appliance into corresponding pulses of light and to send them to or receive them from a remote electrical appliance via the optical waveguide and to convert them into corresponding output data for the electrical appliance. These output data are made available to the electrical appliance, which can process them further, store them or output them, for example.

In this context, the first IC, which is connected directly to the electrical appliance in the case of the known interface device, has the network functionalities required for linking the electrical appliance to the network, that is to say functionalities for controlling, checking and processing the flow of data, such as a logic link control layer (LLC), a media access layer (MAC = Media Access Controller) and a "signal sublayer". These layers represent individual components of the OSI layer model (OSI = Open Systems Interconnection), which describes a general basis for designing and implementing hardware and software for network applications. In this context, the individual layers control the flow of data, for example, or make error recognition and correction functionalities available.

The second IC, which is connected to the first IC, serves as a bidirectional interface between this first IC and the optical connector and converts the data which are to be transmitted by the electrical appliance into pulses which the optical connector can understand. Similarly, this second IC converts data received from the optical connector into data which the electrical appliance can understand.

The optical connector contains an optical transmitter,

such as a light-emitting diode, for transmitting optical pulses at a prescribed wavelength, and an optical receiver, such as a photoreceiver. Suitable connections are used to connect an optical waveguide pair to the optical connector.

SUMMARY OF THE INVENTION

The invention relates to an arrangement for connecting an optical waveguide to a microprocessor-controlled electrical appliance having an arithmetic module which is connected to the electrical appliance and has network functionalities for linking the electrical appliance to a network, an interface chip, connected to the arithmetic module, in the form of an integrated circuit chip, and an optical transmission and reception chip which is connected firstly to the interface chip and secondly to the optical waveguide.

As noted above, the invention specifies a particularly efficient arrangement for connecting an optical waveguide to an electrical appliance.

In one embodiment, there is an arrangement of the aforementioned type in which the interface chip has integrated functional modules which provide at least some of the network functionalities.

Within the context of the invention, functional modules are not necessarily separate electronic components, but rather functional modules of this type are integrated completely in the interface chip; their functionality is provided by means of appropriate logic circuits.

One advantage of the invention is that, besides its function as a bidirectional interface between the arithmetic module and the transmission and reception chip, the interface chip also provides network functionalities, which have normally had to be

performed by the arithmetic module to date. In other words, at least some of the tasks of the arithmetic module have been moved to the interface chip. Since the interface chip is an integrated circuit chip, such integration of further functions is possible - depending on the complexity of the integrated circuit chip - without any great involvement. This measure significantly relieves the load on a microprocessor which is normally present in the arithmetic module. Under some circumstances, it is even possible to resort to a less powerful microprocessor in this case, which lowers the costs for the overall arrangement. In addition, the lower utilization level of dissipated by emanating from the microprocessor, which is a significant advantage for small electrical appliances in closed housings.

One advantageous embodiment of the invention is that at least one functional module integrated in the interface chip provides a switch functionality.

A chip with switch functionality in a network sets up connections between individual electrical appliances in the network, the switch allowing a plurality of electrical appliances to communicate with one another at the same time. This means that, by way of example, it is particularly advantageously possible to implement redundancy changeover, that is changeover from one electrical appliance to a second electrical appliance (of the same type) as smoothly as possible.

A further advantageous embodiment is that at least one functional module integrated in the interface chip provides a filter functionality. This means that, by way of example, received data can be filtered actually in the interface unit and not in the arithmetic module. Since filtering processes are normally arithmetic-intensive operations, moving the filtering

to the interface chip again relieves the load on the arithmetic module's microprocessor.

In line with further advantageous embodiments, the interface chip may be formed, by way of example, by a programmable circuit chip, such as an EPLD (Electronically Programmable Logic Device) or an FPGA (Field Programmable Gate Array), and also by a nonprogrammable circuit chip, such as an ASIC (Application-Specific Integrated Circuit).

An ASIC may advantageously be used particularly in areas where large quantities of the same circuit chip are intended to be manufactured at low manufacturing cost. By contrast, the use of programmable circuit chips, such as an FPGA or an EPLD, is suitable particularly for appliances which are produced in low to medium quantities.

An advantage of these embodiments is, in particular, that the interface chip can be matched to the respectively demanded application on a variable basis. Besides the opportunity to provide almost any network functionalities in a circuit chip of corresponding complexity, producing an optical interface which permits low-power transmission light-emitting diodes to be connected also allows significant minimization of the power loss from the overall arrangement, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail below with reference to exemplary embodiments with respect to the drawings, in which:

Figure 1 shows a schematic view of an exemplary embodiment of an arrangement for linking an optical waveguide to a microprocessor-controlled electrical

appliance.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows (in a frame drawn in dashed lines) an arrangement 1 for linking an optical waveguide pair 2 to a microprocessor-controlled electrical appliance 3 (only the start of which is shown in the figure). The microprocessor-controlled electrical appliance 3 may be, by way of example, a computer, an appliance for telecommunication or a field transmitter, for example in a control system, for controlling the distribution of electricity.

The arrangement 1 has an arithmetic chip 4 which is connected to the electrical appliance 3 by means of appropriate electrical connections 5 - indicated merely schematically in the figure. The arithmetic chip 4 is used to control the data interchange between the electrical appliance 3 and a remotely arranged further electrical appliance via the optical waveguides 2. To this end, the arithmetic chip 4 contains, inter alia, a microprocessor 4a and a "media access controller" (MAC) 4b. The arithmetic chip is also connected via connections 6 to an interface chip 7, which in turn is connected to a transmission and reception chip 9 via further connections 8. The transmission and reception chip contains an optical transmitter 9a, for example in the form of a light-emitting diode, and an optical receiver 9b, for example in the form of a photoreceiver. The transmission and reception chip 9 is connected to the optical waveguides 2 via appropriate optical couplers 10. Normally, a respective optical waveguide is available both for the reception direction and for the transmission direction.

The interface chip 7 is in the form of an integrated circuit chip, such as a programmable circuit chip - for example an FPGA or an EPLD -, or of a nonprogrammable

circuit chip - for example an ASIC. Such integrated circuit chips have the particular advantage that their design can be tailored exactly to their later function of use; it is thus possible to develop an exactly suitable integrated circuit chip for every function of use. For this purpose, there are special design tools, but these will not be discussed in more detail at this juncture. The interface chip 7 serves, in line with its original function, first of all as a converter of data which are to be transmitted from the electrical appliance to the optical transmission and reception chip via the arithmetic chip, or to be received in the opposite direction. To this end, the interface chip 7 converts the data which are output by the arithmetic module 4 on the basis of a standard for optical interfaces (for example PECL = Pseudo Emitter Coupled Logic) and outputs them to the optical transmission and reception chip 9, where they are converted into corresponding pulses of light and are transmitted via the optical waveguides 2. Besides its interface functionality, the interface chip 7 has functional modules 7a, 7b and 7c - indicated merely schematically in the figure - which provide network functionalities. By way of example, the functional module 7a may provide a switch functionality in this case and may thus control the connection of two electrical appliances via a network. The switch functionality may likewise be used to perform rapid redundancy changeover in the event of failure of the electrical appliance 3, in which case there is changeover to an electrical appliance of the same type. By way of example, the functional module 7b represents an electronic filter, e.g. for filtering received data. Since the interface chip 7 is an integrated circuit chip, all such functions may be integrated into it in the form of an appropriate logic circuit designed for the interface chip 7. The performance of the corresponding functions by the interface chip 7 relieves the load on the

microprocessor 4a in the arithmetic chip 4 to a significant extent and increases the efficiency of the entire arrangement overall. If appropriate, it is also possible to resort to a less powerful microprocessor 4a, which would make the overall arrangement less expensive. In addition, relieving the load on the microprocessor 4a means that it is possible to reduce the amount of heat dissipated by the arithmetic chip 4a, which affords the advantage of a lower cooling requirement for the arrangement particularly in the case of a space-saving design for the overall arrangement 1 or when the arrangement is in a small housing. In addition, the fact that the interface chip 7 in the form of an FPGA, of an EPLD or of an ASIC can be tailored to its application on a variable basis means that it is also possible to provide an optical interface having low power loss, for example a TTL interface (TTL = Transistor-Transistor Logic), in this case. This allows less powerful light-emitting diodes to be actuated in the transmission and reception chip 9 and allows the power consumption and hence the heat dissipation of the overall arrangement 1 to be significantly reduced.

In comparison with hitherto frequently used "PHY transceivers" as interface chips, which frequently provide both an optical and an electrical interface, consciously omitting the electrical interface also allows the power loss and hence the evolution of heat from the overall arrangement 1 to be kept comparatively low.

The overall arrangement 1 may be held, by way of example, in an external housing and may be connected to the electrical appliance 3 by means of an appropriate interface connection. Normally, however, the arrangement 1 will be implemented on a push-in printed circuit board, for example, and will be inserted into

~~the electrical appliance 3. In such a case, the reduced evolution of heat from the arrangement 1 is also of benefit to the overall electrical appliance.~~

Abstract

ARRANGEMENT FOR CONNECTING AN OPTICAL WAVEGUIDE TO A MICROPROCESSOR-CONTROLLED ELECTRICAL APPLIANCE

The invention relates to an arrangement for connecting an optical waveguide to a microprocessor-controlled electrical appliance having an arithmetic module which is connected to the electrical appliance and has network functionalities for linking the electrical appliance to a network, an interface chip, connected to the arithmetic module, in the form of an integrated circuit chip, and an optical transmission and reception chip which is connected firstly to the interface chip and secondly to the optical waveguide. In order to make such an arrangement particularly efficient, provision is made for the interface chip to have integrated functional modules which provide at least some of the network functionalities.